MASTER IN BIOLOGICAL AND MEDICAL SCIENCES

Main Language of Instruction:
French ☑ English ○ Arabic ○

Campus Where the Program Is Offered: CSM

OBJECTIVE

The Master in Biological and Medical Sciences aims to train students to adopt a reflective and analytical approach by introducing them research in the most competitive fields of life sciences and health. This program enables future medical students to pursue doctoral studies (PhD), combine an academic career with clinical practice, and/or join a specialized research center (health and medicine).

The Master in Biological and Medical Sciences compromises 5 concentrations:
- Physiology and Pathophysiology
- Neuroscience
- Genetics and Molecular Biology
- Cancerlogy
- Biomechanics and Medical Imaging

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

- Explain cellular and molecular concepts and mechanisms, and describe experimental protocols in different biomedical disciplines.
- Use scientific search engines such as PubMed.
- Take responsibility for ethics and bioethics.
- Operate research laboratory tools.
- Apply proper research laboratory practices.
- Handle laboratory animals for scientific purposes.
- Collaborate effectively in a research team with an inclusive spirit, jointly establishing schedules, assigning tasks, and achieving objectives.
- Apply experimental methods and techniques to meet objectives.
- Communicate effectively with colleagues, laboratory members, and diverse audience.
- Write a scientific article.
- Publicly present research work.

ADMISSION REQUIREMENTS

Candidates are selected based on the examination of an official form submitted with required documents to the academic secretary's office and following an oral interview.

- Admission to Master 1 (first and second semester of The Master in Biological and Medical Sciences): Open to USJ medical students having completed and validated their first cycle of medical studies and started the second cycle, and/or specialty residents and/or practicing doctors.
- Admission to Master 2 (third and fourth semesters)
  - USJ Medical students who have completed Master 1, selected based on performance.
  - USJ pharmacy students who have obtained their pharmacy diploma and completed Master 1 at their faculty, provided the chosen option is not offered in their own faculty.
  - USJ students from the Faculty of Sciences who have obtained their Bachelor and Master 1 from their faculty, provided the chosen option is not offered in their own faculty.

PROGRAM REQUIREMENTS

Master 1 (First and second semesters)
60 credits: Required courses (45 Cr.: 30 Cr. granted by equivalence from the FCMS to USJ SCMS medical students, and 35 Cr. granted by equivalence to residents and practicing doctors), Institution's elective courses (15 Cr. for SCMS students and 10 Cr. for residents and practicing doctors).

For SCMS students, 30 Cr. are granted by equivalence from the FCMS: Biomedical Statistics (2 Cr.). Metabolic Biochemistry (2 Cr.). Nutrition and Metabolism of Healthy Human Beings (2 Cr.). Fundamental Immunology (3 Cr.). English for Specific Purposes: Health Studies (4 Cr.). Introduction to Pharmacology (3 Cr.). Medical Bacteriology (3 Cr.). Parasitology and Medical Mycology (2 Cr.). Physiology of Aging (3 Cr.). Medical Virology (2 Cr.). Mental Health (2 Cr.). Introduction to Biophysical and Biomechanical Disorders (2 Cr.).

For residents and practicing doctors, 35 Cr. are granted by equivalence from the FCMS and the medical speciality exam (CEPD) : Biomedical Statistics (2 Cr.). Metabolic Biochemistry (2 Cr.). Nutrition and Metabolism of Healthy Human Beings (2 Cr.). Fundamental Immunology (3 Cr.). English for Specific Purposes: Health Studies (4 Cr.). Introduction to Pharmacology (3 Cr.). PM01 Medical Bacteriology (3 Cr.). Parasitology and Medical Mycology (2 Cr.). Physiology of Aging (3 Cr.). Medical Virology (2 Cr.). Mental Health (2 Cr.). Introduction to Biophysical and Biomechanical Disorders (2 Cr.). Specialized Medicine (5 Cr.).

Institution's Elective Courses (15 Cr.)
To choose three courses from a list for SCMS students and two courses for residents and practicing doctors (in the latter case, one course entitled 'Specialized medicine' is granted by equivalence and is added to the 30 Cr. previously granted), Biomechanics and Medical Imaging: Gait Analysis and Study of the Human Skeleton (5 Cr.). Genetics and Molecular Biology: Oncogenetics. Karyotyping and Techniques (5 Cr.). Molecular and Cellular Physiopathological Bases of Human Diseases (5 Cr.) . Metabolism of Cancer Cells and their Signaling Pathways (5 Cr.). Neurosciences: Neuromodulation of Pain (5 Cr.). Public Health Policies and Systems (5 Cr.).

Master 2 (Third and fourth semesters)
- Common Courses: Scientific Research Methodology (3 Cr.). Bio Statistics (2 Cr.). Biotechnologies (1 Cr.). Introduction to Laboratory Work (1 Cr.). Bio Informatics (1 Cr. .). Cellular Biology (2 Cr.).
- Courses for the Physiology and Pathophysiology concentration: Experimental Physiology (2 Cr.). Introduction to Channelopathies (2 Cr.). Physiology and Pharmacology of Membrane Transporters (2 Cr.). Stress and Heart (2 Cr.). Stress and Kidney (2 Cr.).
- Courses for the Biomechanics and Medical Imaging concentration: Movement Analysis (3 Cr.). 3D Reconstruction of the Skeleton (4 Cr.). Data Analysis. Presentation of Results and Medical Writing (3 Cr.).
- Courses for the Cancerology concentration: The Biology and Nature of Cancer (2 Cr.). The Characteristics of Cancer Cells (2 Cr.). The Metabolism of Cancer Cells (2 Cr.). Techniques Molecular and Cellular Biochemistry (2 Cr.). Analysis of Articles and Writing of Research Projects (2 Cr).
- Courses for the Neuroscience concentration: Pain: Normal and Pathological Neurobiology (2 Cr.). Pain Management (2 Cr.). Unraveling the Mystery of the Insula Lobe (1 Cr.). Cognitive Neurosciences (2 Cr.). Neurostimulation for the Treatment of Pathologies of the Nervous System (2 Cr.). Electrophysiology of the Nervous System (1 Cr.).
- Courses for the Genetics and Molecular Biology concentration: Molecular Bases of Pathologies (2 Cr.). Oncogenetics (2 Cr.). New Technologies Workshops (2 Cr.). Therapies and Personalized Medicine (2 Cr.). Imprinting and Genomic Regulation (2 Cr.).
- MMII Research Dissertation (10 Cr.)
- Research Internship (30 Cr.).

SUGGESTED STUDY PLAN

Semester 1 & 2 of the Master 1 degree (M1) : 60 Cr.
- SCMS students choose 3 courses from the 6 courses marked by an asterix listed in the table below.
- Residents and practicing doctors choose 2 courses.

Each course counts for 5 Cr.

Code	Course Name	Credit
002BIOMM2	*Biomechanics and Medical Imaging: Gait Analysis and Study of the Human Skeleton	5
002CGENM2	*Genetics and Molecular Biology: Oncogenetics, Karyotyping and Techniques	5
002BPCMM2	*Molecular and Cellular Pathophysiological Basis of Human Diseases	5
002NEURM2	*Neuroscience: Neuromodulation of Pain	5
002METAM2	*Cancer Cell Metabolism and their Signaling Pathways	5
496PGSPM2	*Public Health Policies and Systems	5
002MERFM2	Mandatory: Methodology and Ethics in Fundamental Research	5
002STAGM2	Mandatory: Observation and Research Initiation Course	10
002MESPM	Specialized Medecine	5
	Granted Credits	30
	Total	**60**

Semester 3 & 4 of the Master 2 degree (M2)

Code	Course Name	Credit
Common Courses (Total of 10 Cr.)		
002TCMSM8	Scientific Research Methodology	3
002TCBIM8	Bioinformatics	1
002TCTLM8	Introduction to Laboratory Work	1
002TCBTM8	Biotechnology	1
002TCBCM8	Cellular Biology	2
002TCEBM8	Biostatistics	2
	Courses Per Major	10
002STLBM4	Research Internship	30
002MMIIM2	Research Paper	10
Total		**60**

COURSE DESCRIPTION

COMMON COURSES

002TCMSM8 Scientific Research Methodology 3 Cr.

This course explains and describes various techniques and tools used in a research laboratory across different biomedical disciplines. These include western blot, immunofluorescence, immunohistochemistry, GST Tag or His tag pull down, partner search (Double hybrid, Modeling), Co-immunoprecipitation, Proteomics, cell culture, immortalized cells, cell transfections, molecular cloning, transgenesis and applications, studies of Apoptosis and Necrosis, flow cytometry, animal models in medical research, qualitative PCR, RT-PCR, PCR in real time, Search for mutations, sequencing, restriction mapping, Southern blot, DNA microarrays, strategies for identifying new genes involved in pathology.

002TCEBM8 Bio Statistics 2 Cr.

This course covers the identification and application of statistical tools in a research project. It explores topics such as statistics and probability: statistics, population and sample, mathematical reminders: set, elements, function, inverse function, integrals, random variables: representation of a finite probability law, mathematical expectation of a finite law, variance and standard deviation, product probability law. This course also examines examples of distributions: discrete laws, continuous laws, X2 law, Student's law, exponential law. Students will study fluctuations of the experimental mean (the experimental mean random variable): properties of the experimental average, study of the normal distribution, evaluation of the diagnostic interest of medical information: introduction (the diagnosis, medical information, experimental situation and estimation), the parameters of the evaluation (a representative sample, two samples representative), notion of decision support: notion of utility, decision trees, use of statistical software.

002TCBTM8 Biotechnology 1 Cr.

This course covers the following: the importance and contribution of biotechnology in research: Pharmaceutical biotechnology: identification of molecular targets and drug design in the field of cardiovascular, degenerative and inflammatory diseases as well as cancer. ; Bioprocesses: innovation and development of processes from design to industrial production by exploiting the use of microorganisms, enzymes and animal cells or insects as biocatalysts; Bio environment (Bio polymers, Bio pesticides, Bio surfactants); Plant and animal biotechnology (Genetically Modified Organisms): production applications, public health issues; Tissue culture; Production of enzymes (Biomaterials).

002TCTLM8 Introduction to Laboratory Work 1 Cr.

This course explains the dangers of handling products, environmental protection measures, and good animal testing practices.

002TCBIM8 Bio Informatics 1 Cr.

This course explains the importance and contribution of biotechnology in research: research of gene and protein sequences. It covers the following topics: Search for primers; Base alignment; Prediction of 3D structures of proteins and their interactions with DNA or proteins; Mapping (distribution of genes on chromosomes); Comparison of the genomes of different organisms; Application: GMOs, bacteria, fungi, yeasts.

002TCBCM8 Cellular Biology 2 Cr.

This course explains the geopolitics of the cell and its impact on the homeostasis of the organism: Reminder on the general organization of the eukaryotic cell (Cell biology methodologies); The Hallmarks of Cancer; In and Out of the cell (Cellular membranes, macro-domains and micro-domains, Trans-membrane transport); Cytoskeleton; Cellular dynamics; Molecular mechanisms; Cell-cell relationship and cell with its environment.

COURSES FOR THE PHYSIOLOGY AND PATHOPHYSIOLOGY CONCENTRATION

002PHECM3 Experimental Physiology 2 Cr.

This course is delivered in the 4th semester. It includes lectures and practical work. It plays a crucial role in the program, particularly for integrating technical knowledge into the research internship, and developing appropriate experimental approaches.

002INCAM3 Introduction to Canalopathies 2 Cr.

This course is delivered in the 4th semester. It includes lectures and practical work. It aims to develop knowledge on the experimental approach to the study of ion channels and their role in normal and pathological physiological processes.

002TSPPM8 Physiology and Pharmacology of Transmembrane Transporters 2 Cr.

This seminar is delivered in the 4th semester. It aims to develop knowledge on membrane transporters: nature, functions and pharmacological control.

002STCOM3 Stress and the Heart 2 Cr.

This seminar is delivered in the 4th semester. It aims to develop knowledge of cardiac function when it is subject to metabolic and mechanical constraints.

002STREM3 Stress and the Kidney 2 Cr.

This course is delivered in the 4th semester. It includes lectures and practical work. It aims to develop knowledge on renal function when it is subject to metabolic and mechanical constraints.

COURSES FOR THE BIOMECHANICS AND MEDICAL IMAGING CONCENTRATION

002ANDMM4 Movement Analysis 3 Cr.

This course develops knowledge of techniques and methodologies in musculoskeletal biomechanics, particularly important in fundamental and clinical research: It includes the use of movement acquisition equipment; Pre-acquisition calibration; Place markers on subjects; Static and dynamic acquisitions; Data processing on different software; Backup of data on different servers; Data extraction and clinical use; Proposal for medical treatment upon seeing the results.

002RTDSM4 3D Reconstruction of the Skeleton 4 Cr.

This course develops knowledge of techniques and methodologies in musculoskeletal biomechanics, particularly important in fundamental and clinical research:Use of tools for EOS radiography; Positioning of the subject during acquisition; Contribution to taking x-rays and transfer to different stations and servers; 3D reconstruction of the spine; 3D reconstruction of the lower limbs; 3D reconstruction of the pelvis; 3D reconstruction of the rib cage; 3D reconstruction of the cervical spine; 3D reconstruction of the healthy hip and the prosthetic hip; 3D reconstruction using the Posture module; Data extraction and clinical use.

002ADRMM4 Data Analysis, Presentation of Results and Medical Writing 3 Cr.

This course develops knowledge in statistical analyses, abstract writing, article writing, poster preparation and oral presentation preparation: Statistical analysis: choice of suitable statistical tests, use of statistical software; Writing an abstract for a conference; Writing research manuscript; Prepare a poster; Prepare an oral presentation; Participation in various research meetings in the laboratory with the entire team: doctors, residents, doctoral students and interns.

COURSES FOR THE CANCEROLOGY CONCENTRATION

002BNDCM4 Biology and Nature of Cancer 2Cr.

This course aims to introduce students to the world of the cancer cells, including their initiation, progression, and genetic modifications. By the end of this course, students will be able to: know the necessary steps and the points of no return for the development of a cancer cell; know and understand the most probable and most studied causes, at the molecular level, which cause cancer; and understand the response of cancer cells to growth factors

002CDCCM4 Characteristics of Cancer Cells 2 Cr.

This course aims to explain the characteristics and behaviors that distinguish a cancer cell from a normal cell. This is essential to guide a research project and put it on the right track. By the end of this course, students will be able to: Know the specific characteristics of a cancer cell; distinguish the differences between a cancer cell and a normal cell; and understand the messy behavior of a cancer cell versus a normal cell.

002MDCCM4 Metabolism of Cancer Cells 2 Cr.

This course explores the significant differences between the metabolism of cancer cells and normal cells, highlighting how these metabolic changes can contribute to the initiation and progression of cancers. By the end of this course students will be able to: Know the difference between a normal cell and a cancerous cell; explain the Warburg effect and aerobic glycolysis; and establish the interrelationship between the anabolic pathways most activated in cancer cells.

002TBMCM4 Cellular and Molecular Biochemical Techniques 2 Cr.

This course aims to introduce students to the different basic techniques used in a cancer laboratory. By the end of this course, students will be able to: Explain and/or practice cell culture; Explain and/or practice DNA and RNA extraction; explain and/or practice RT-PCR and qPCR; explain and/or practice the SSCP; explain and/or practice site-directed mutagenesis; and explain and/or practice protein electrophoresis.

002ARPRCM4 Analysis of Articles and Writing of Research Projects 2Cr.

This course aims to train students to write a research project and to read and analyze scientific articles. By the end of this course, students will be able to:Write and set up a research project; analyze a scientific article; and prepare and present scientific projects.

COURSES FOR THE NEUROSCIENCE CONCENTRATION

002DNNPM4 Pain : Normal and Pathological Neurobiology 2 Cr.

This course is delivered in the 3rd semester. It includes lectures and critical analysis of scientific articles. This course is essential for understanding pain, a significant topic in neuroscience and an important societal issue. It provides students with a detailed understanding of pain (classification, pathways, control and modulation structures, etc.) via the analysis of functional neuroimaging studies.

002PECDM4 Pain Managment 2 Cr.

This course is delivered in the 3rd semester. It includes lectures and critical analysis of scientific articles. This course develops the student's ability to think critically about science. It discusses various methods for managing pain, a significant issue in society and the field of neuroscience.

002LMLIM4 Resolving the Mystery of the Insula Lobe 1 Cr.

This course is delivered in the 3rd semester. It includes analysis of scientific articles. It plays a crucial role in the program, equipping students with bibliographic research skills, and developing a sense of synthesis. By the end of this course students will be able to: Know the anatomical organization of the lobe of the insula; mention the different roles assigned to each subpart of the insula, describe the results of electrophysiological studies targeting the insula; and interpret the results of neuroimaging studies investigating the insula.

002TPSNM4 Cognitive Neurosciences 2 Cr.

This course is delivered in the 4th semester. It includes lectures and critical analysis of scientific articles. It plays a crucial role in Neuroscience teaching, particularly for the acquisition of the concepts of functional regionalization of the brain and connectivism. By the end of this course students will be able to: Describe the physiopathology of various memory processes; mention animal models and behavioral tests used to study Alzheimer's disease; know the principle of addiction as well as the reward system; describe the neurobiology of waking and sleeping states, as well as circadian rhythms; and recognize the role of the prefrontal cortex in the control of executive functions.

002TPSNM4 Neurostimulation for the Treatment of Nervous System Pathologies 2 Cr.

This course is delivered in the 4th semester. It includes lectures and critical analysis of scientific articles. It plays a crucial role in Neuroscience teaching, for the acquisition of knowledge on neurostimulation techniques which are increasingly used in the neurosurgical environment for the treatment of various pathologies of the nervous system. Students will analyze the contributions of functional neuroimaging and electrophysiology in understanding the mechanisms of action of various neurostimulation techniques. By the end of this course, students will be able to identify the target structures in neurostimulation for the treatment of pain, abnormal movements, epilepsy, tinnitus, headaches, and psychiatric pathologies, as well as describe the mechanisms of action of these neurostimulation techniques.

002EDSNM4 Nervous System Electrophysiology 1 Cr.

This course is delivered in the 4th semester. It includes lectures, "journal club" and practical internships. It aims to provide students with a broad vision of the different electrophysiology techniques which make it possible to understand the nervous system from cellular aspects to the functionality of different structures. By the end of this course students will be able to: Describe the principle of epidural stimulation and subdural stimulation; Recognize the means of achieving cortical, deep and peripheral stimulation; Know the principle of unitary extracellular recording in vivo; Analyze an electrophysiological trace; Apply electromyographic recordings; and know the general principles of various electrophysiological techniques.

COURSES FOR THE GENETICS AND MOLECULAR BIOLOGY CONCENTRATION

002BMDPM4 Molecular Bases of Pathologies 2 Cr.

002ONGEM4 Oncogenetics 2 Cr.

002AENTM4 New Technology Workshops 2 Cr.

002TEMPM4 Therapies and Personalized Medicine 2 Cr.

002EERGM4 Imprinting and Genomic Regulation 2 Cr.

This program updates student's knowledge in clinical and molecular genetics and human pathologies, providing a deeper understanding of research and publication procedures before embarking on doctoral studies and engaging with leading scientists. Students will attend the European Society of Human Genetics (ESHG) conference held annually in Europe for 4-5 days (48 hours) in English, or the genetics conference which takes place every 2 years in France and is conducted in French. Attendance at these conferences is validated as credits for all students.

002MMIIM2 Research Thesis 10 Cr.

This research thesis presented at the end of the second year of this program (semester 4) is worth 10 Cr. ; It describes the research work carried out by students, and is supported before a reading committee jury. It adheres to specific requirements in terms of presentation and writing.

002STLBM4 Research Internship 30 Cr.

This internship lasts 6 to 8 months and takes place in a research laboratory affiliated with the faculty of medicine. The work focuses on a research project related to the chosen concentration. The scientific direction is carried out by an authorized full-time teacher-researcher with the appropriate academic qualifications.